Advanced Manufacturing Industry Analysis

ECONOMIC SECTOR ANALYSIS

Report ESA-0701-1
July 2001

MISSOURI
RESEARCH AND PLANNING
DEPARTMENT of ECONOMIC DEVELOPMENT

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Key Findings

- Advanced manufacturing employment in Missouri was estimated at 121,520 in 2000, a decrease of -20.9% since 1990. In 2000, the advanced manufacturing industry accounted for 4.6% of total employment in Missouri. The majority of advanced manufacturing jobs were located in metropolitan St. Louis, Kansas City, Springfield and Columbia.
- Total annual real wages during 2000 in the advanced manufacturing industry in Missouri was estimated at $6.37 billion, a decrease of -9.1% since 1990. Estimated annual average real wages per job was $52,430, an increase of 14.9% since 1990. In 2000, the advanced manufacturing industry accounted for 7.8% of total wages in Missouri.
- The advanced manufacturing industry accounts for 18.5% of Missouri's GSP, which is equivalent to $29.8 billion dollars in 2001. The advanced manufacturing industry accounts for the largest percent of GRP in the Kansas City Metro Region (41.8%), the St. Louis Metro Region (25.6%), and the South Central Region (20.9%). However, in terms of GRP dollars the advanced manufacturing industry is largest in the St. Louis Metro Region ($13.2 billion), the Kansas City Metro Region ($4.1 billion), St. Louis ($3.0 billion), Springfield Region ($1.8 billion), and Kansas City ($1.7 billion).
- The direct employment 121,520 jobs in the advanced manufacturing industry created an additional 303,280 ancillary jobs in Missouri's economy, resulting in a total impact of 424,800 jobs and $16.5 billion in wages across Missouri - which translates into an annual average wage per job of $38,912.
- Both directly and indirectly, the advanced manufacturing industry has the greatest impact on the Durable Manufacturing sector (117,100 jobs at $47,831 per job); the Services sector (98,660 jobs at $33,458 per job); the Retail Trade sector (60,160 jobs at $17,254 per job); and the Non-Durable Manufacturing sector (38,360 jobs at $64,520 per job). It appears that the Mining, Agriculture/Forestry/Fishing and Government sectors are marginally impacted.
- Regions most positively affected by the advanced manufacturing industry include the St. Louis Metro Region (185,500 jobs at $44,927 per job); the Kansas City Metro Region (50,960 jobs at $38,462 per job); St. Louis (35,800 jobs at $48,855 per job); and Kansas City (31,650 jobs at $43,223 per job). In general, most other regions in the state are only moderately impacted by the advanced manufacturing industry.
- Both directly and indirectly, the advanced manufacturing industry supports four main occupational groups in Missouri: (1) 56.8% of all Assembly and Fabrication Hand Workers in the state, comprising 25,110 employees in the industry; (2) 43.1% of all Plant and Utility Operators in the state, comprising 1,636 employees in the industry; (3) 39.8% of all Precision Production workers in the state, comprising 20,767 employees in the industry; and (4) 34.9% of all Machine Operators and Setters in the state, comprising 29,374 employees in the industry.

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Analysis and Reporting by David J. Peters.

I. Overview

Advanced manufacturing enjoys high visibility. Industry developments are tracked closely in the United States and abroad, and its implications for productivity, international competition, national defense and the general standard of living are of increasing interest (Riche et al. 1983). For example, according to the testimony of Alan Greenspan, Chairman of the Federal Reserve Board, dramatic improvements in computing power, communication and information technology are resulting in higher rates of productivity growth and higher real wages (US House of Representatives 1998). Given these developments, state and local officials in Missouri need to know how advanced manufacturing affects the regional and state economy.

The Bureau of Labor Statistics defines advanced manufacturing, or high technology, as those firms engaged in the design, development, and introduction of new products and innovative manufacturing processes through the systematic application of scientific and technical knowledge (Hecker 1999). These firms typically use state-of-the-art techniques, devote a high proportion of expenditures to research and development, and employ a high proportion of scientific, technical and engineering personnel. In this analysis, manufacturing industries are considered high tech or advanced if employment in both research and development and in all technology-oriented occupations accounted for a proportion of employment that was at least twice the average for all industries in the Occupational Employment and Statistics survey.

Research and Planning at the Missouri Department of Economic Development conducts comprehensive analyses of key economic sectors within Missouri's economy. Economic Sector Analyses (ESAs) assist state and local officials in determining the economic importance of a particular industry at the county-level. ESAs are used to: (1) identify which counties have a large concentration of employment and wages in a particular industry; (2) identify which counties have a competitive advantage in a particular industry; (3) identify where firms are located in a particular industry; (4) assess statewide employment and wage impacts of a particular industry in the current year; and (5) forecast statewide employment, wage and tax revenue impacts of a particular industry over 10 years. ESAs use detailed sector data (Covered Employment and Wages, formerly ES-202) to determine employment and wages in a particular industry at the county-level. This flexibility allows for the creation of unique and customized aggregate economic sectors.

II. Methods

The advanced manufacturing industry in Missouri is analyzed using specialization ratios and econometric models. Advanced manufacturing industry employment and wages was obtained from Covered Employment and Wages (formerly ES-202) data, maintained by the Missouri Department of Economic Development. The advanced manufacturing industry is defined using a classification developed by the Bureau of Labor Statistics. Advanced manufacturing firms are engaged in the design, development, and introduction of new products and innovative manufacturing processes through the systematic application of scientific and technical knowledge. Refer to Appendix A for a full list of SICs.

Specialization ratios (SRs), also known as location quotients, are used to describe the dispersion of the advanced manufacturing industry across Missouri. SRs measure a county's employment concentration in a given industry relative to the state average. Comparing these ratios over time gives an indication of the relative strengths and weaknesses of the industry. SRs greater than 1.0 indicate that the county is relatively more specialized in an industry relative to the state as a whole; or that the county has a comparative advantage in that industry. SRs less than 1.0 indicate that the county is less specialized in an industry relative to the state as a whole, which may indicate an area for potential growth; or that the county does not have a comparative advantage in that industry.

It is important to note that SRs measure the proportion of industry employment relative to the state average, and ***not*** the total number of jobs. Therefore, although St. Louis may have the largest number of employees within the advanced manufacturing industry, it may account for only a small percentage of total employment – leading to a small SR. It is also important to note that the following SRs are normalized to the Missouri mean. In general, SRs are most informative when normalized to the national mean. However, national data was not available at this level of sector detail.

The formula for a SR is given below:

$$SR_{sector} = \left(\frac{\left(\frac{SECTOR\_EMPLOYMENT_{county}}{TOTAL\_EMPLOYMENT_{county}} \right)}{\left(\frac{SECTOR\_EMPLOYMENT_{state}}{TOTAL\_EMPLOYMENT_{state}} \right)} \right)$$

The REMI Missouri Multi-Regional **econometric model** is utilized to forecast economic impacts at the regional and state level. REMI includes a model that has been built for Missouri's 17 economic regions. The model-building system uses hundreds of programs developed over the last two decades to build customized models for each area using data from the Bureau of Economic Analysis, the Bureau of Labor Statistics, the Department of Energy, the Census Bureau and other public sources.

The REMI model is a structural model, meaning that it clearly includes cause and effect relationships. The model shares two key underlying assumptions with mainstream economic theory: households maximize utility and producers maximize profits. Since these assumptions make sense to most people, the model can be understood by intelligent lay people as well as trained economists. In the model, businesses produce goods to sell to other firms, consumers, investors, governments and purchasers outside of the region. The output is produced using labor, capital, fuel and intermediate inputs. The demand for labor, capital and fuel per unit of output depends on their relative costs, since an increase in the price of any one of these inputs leads to substitution away from that input to other inputs. The supply of labor in the model depends on the number of people in the population and the proportion of those people who participate in the labor force. Economic migration affects the population size. People will move into an area if the real after-tax wage rates or the likelihood of being employed increases in a region.

Supply and demand for labor in the model determines the wage rates. These wage rates, along with other prices and productivity, determine the cost of doing business for every industry in the model. An increase in the cost of doing business causes either an increase in price or a cut in profits depending on the market for the product. In either case, an increase in cost would decrease the share of the local and US market supplied by local firms. This market share combined with the demand described above determines the amount of local output. Of course, there are also many other feedbacks in the model such as the feedback from changes in wages and employment to income and consumption, the feedback of economic expansion to investment, and the feedback of population to government spending.

III. Industry Analysis

Industry Trends

In Missouri, employment and wages in the advanced manufacturing industry have declined over the last decade. At the same time, however, average wages per job and number of establishments in the advanced manufacturing industry have increased since 1990. Advanced manufacturing employment in Missouri was estimated at 121,520 in 2000, a decrease of -20.9% since 1990. Total annual real wages during 2000 in the advanced manufacturing industry in Missouri was estimated at $6.37 billion, a decrease of -9.1% since 1990. Estimated annual average real wages per job during 2000 in the advanced manufacturing industry was $52,430, an increase of 14.9% since 1990. The number of advanced manufacturing firms in Missouri in 2000 was estimated at 1,348, an increase of 15.3% since 1990.

In 2000, the advanced manufacturing industry accounted for 4.6% of total employment and 7.8% of total wages in Missouri. The annual average wage per job during 2000 in the advanced manufacturing industry was $52,430, well above the state average wage per job of $31,217. Refer to Table 1.

Table 1
Advanced Manufacturing Economic Indicators, 1990-2000

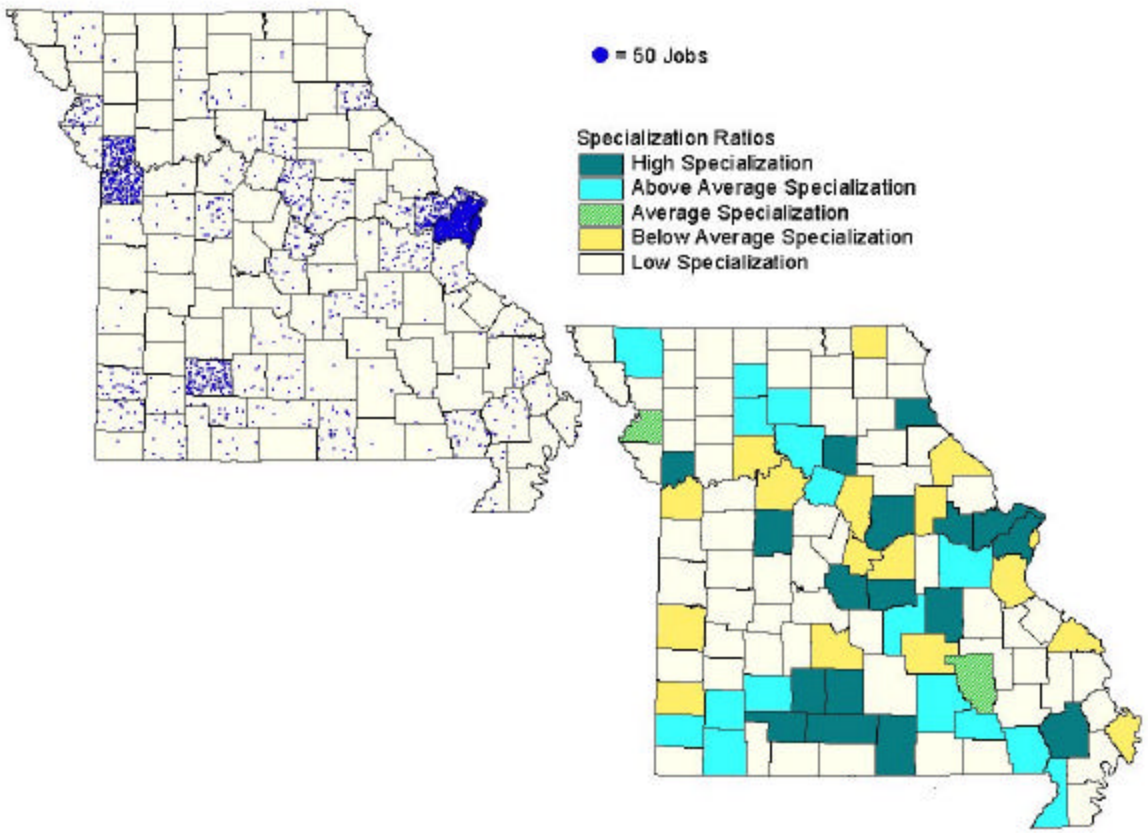
INDICATOR	1990	2000	Percent Change
Total Employment (Percent of Total Missouri Employment)	153,673 (6.9%)	121,520 (4.6%)	-20.9% ↓
Total Wages, in Millions of 2000 Dollars (Percent of Total Missouri Wages)	$7,014.2 (11.1%)	$6,372.9 (7.8%)	-9.1% ↓
Annual Average Wage Per Job, in 2000 Dollars (Missouri Annual Average Wage Per Job)	$45,637 ($28,462)	$52,430 ($31,217)	14.9% ↑
Total Establishments	1,168	1,348	15.3% ↑

Source: Covered Employment and Wages, Missouri Department of Economic Development.

In 2000, the majority of advanced manufacturing jobs were located in metropolitan St. Louis, Kansas City, Springfield and Columbia. Counties with the largest employment base were St. Louis (45,976), Jackson (11,295), St. Louis City (7,492), Greene (7,131), St. Charles (6,916), Clay (6,857), Boone (2,839) and Franklin (2,071).

According to specialization ratios (location quotients), 17 Missouri counties were highly specialized in advanced manufacturing employment. These areas were concentrated in south-central Missouri and in metropolitan St. Louis. The most specialized counties in the state were Douglas (4.31), Wright (2.60), Marion (2.43), Randolph (2.22), Miller (2.04), Howell (1.99), Callaway (1.86), Warren (1.86), Pettis (1.78), Clay (1.77), Crawford (1.73), Christian (1.60), Stoddard (1.57), St. Charles (1.57), St. Louis (1.54) and Webster (1.52). It is important to note that SRs measure the proportion of industry employment relative to the state average, not the total number of jobs. Refer to Map 1.

Map 1
Advanced Manufacturing Employment and Specialization, 2000

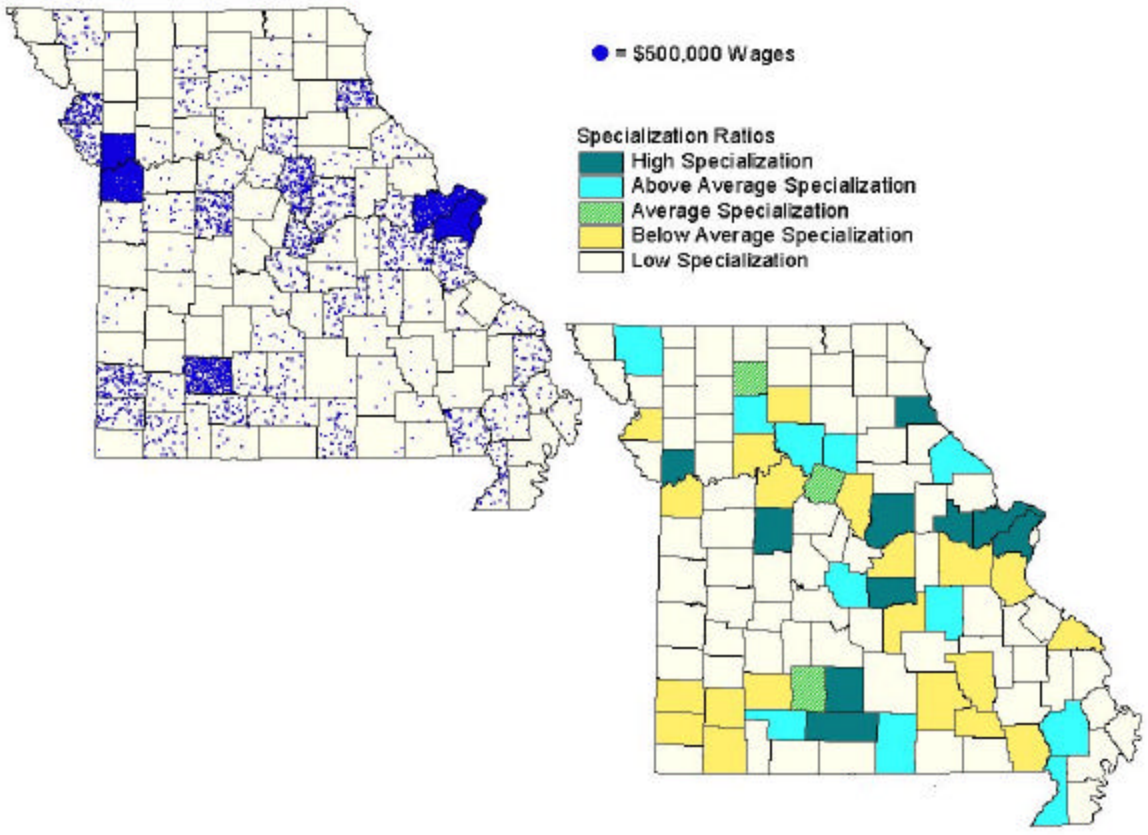


Source: Covered Employment and Wages, Missouri Department of Economic Development.

In 2000, the majority of advanced manufacturing wages were located in metropolitan St. Louis, Kansas City, Springfield and Columbia. Counties with the largest wage base were St. Louis ($3,123.9 million), Jackson ($624.7 million), Clay ($483.2 million), St. Charles ($402.3 million), St. Louis City ($368.9 million), Greene ($234.1 million), Boone ($101.9 million) and Buchanan ($78.2 million).

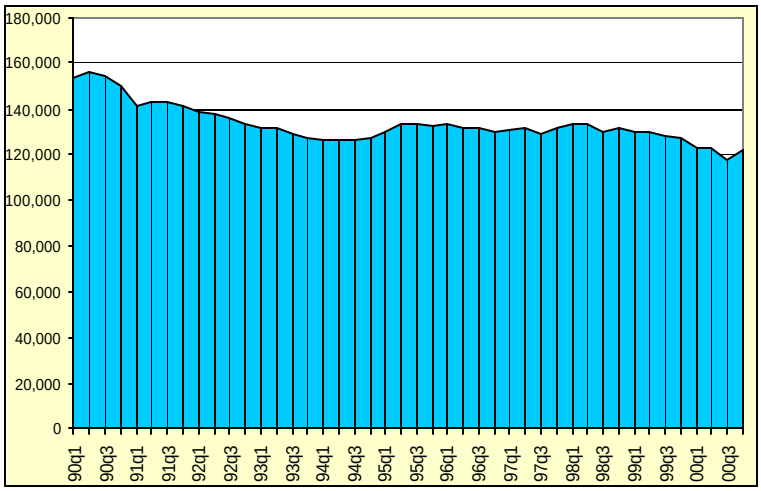
According to specialization ratios (location quotients), 10 Missouri counties were highly specialized in advanced manufacturing wages. These areas were concentrated in south-central Missouri and in metropolitan St. Louis. The most specialized counties in the state were Douglas (4.35), Clay (2.30), Wright (1.97), Marion (1.94), St. Charles (1.84), Pettis (1.77), Warren (1.64), St. Louis (1.64) and Callaway (1.58). It is important to note that SRs measure the proportion of industry wages relative to the state average, not the total number of wages. Refer to Map 2.

Map 2
Advanced Manufacturing Wages and Specialization, 2000



Source: Covered Employment and Wages, Missouri Department of Economic Development.

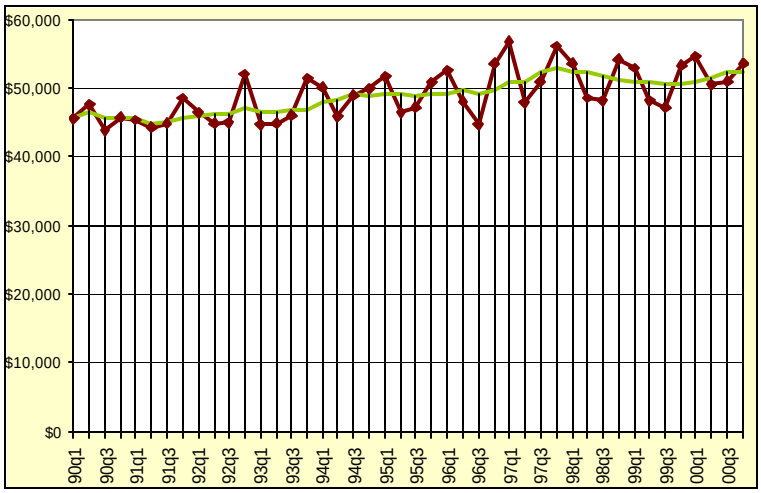
EMPLOYMENT TRENDS, 1990-2000



- Advanced manufacturing employment in Missouri has decreased by -20.9% since 1990.
- The most current data estimates 121,520 advanced manufacturing jobs during 2000.
- Employment was highest during 2nd quarter 1990, with 156,379 jobs. Employment was lowest during 3rd quarter 2000, with 118,168 jobs.

Source: ES-202, MO Department of Economic Development

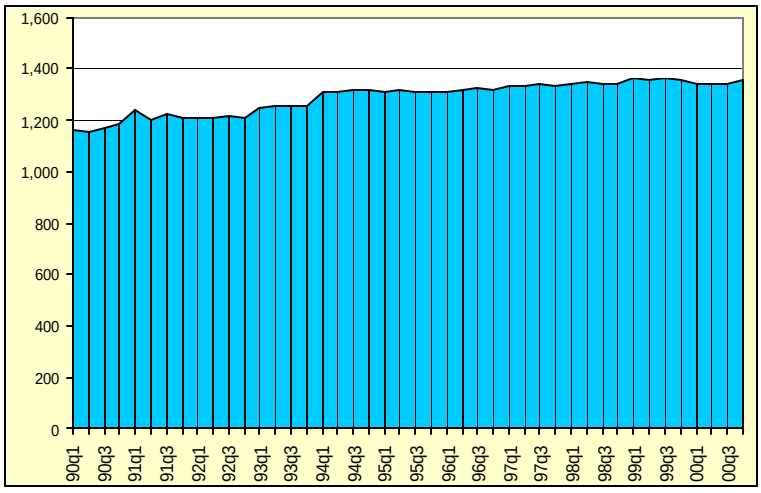
ANNUAL AVERAGE WAGE PER JOB, 1990-2000



- Annual average wages per job in advanced manufacturing has increased by 14.9% since 1990.
- The most current data estimates an average wage per job of $52,430 during 2000 - much higher than the state average wage of $31,217.
- Average wages per job were highest during 1st quarter 1997, at $56,816 per job. Average wages per job were lowest during 3rd quarter 1990, at $43,776 per job.

Green line represents four quarter rolling average.
Wages adjusted to 2000 real dollars. Quarter wages annualized.
Source: ES-202, MO Department of Economic Development

ESTABLISHMENT TRENDS, 1990-2000



- The number of advanced manufacturing establishments in Missouri has increased by 15.3% since 1990.
- The most current data estimates 1,348 advanced manufacturing establishments during 2000.
- Establishments were most numerous during 3rd quarter 1999, at 1,364 entities. Establishments were least numerous during 2nd quarter 1990, at 1,156 entities.

Source: ES-202, MO Department of Economic Development

Gross Regional/State Product

Gross state product (GSP) and gross regional product (GRP) for each state/region is derived as the sum of the gross state/regional product originating in all industries in the state/region. In concept, an industry's GSP/GRP, or its value added, is equal to its gross output (sales or receipts and other operating income, commodity taxes, and inventory change) minus its intermediate inputs (consumption of goods and services purchased from other U.S. industries or imported). Thus, GSP/GRP is often considered the state/regional counterpart of the national gross domestic product (GDP).

The advanced manufacturing industry accounts for 18.5% of Missouri's GSP, which is equivalent to $29.8 billion dollars in 2001. The advanced manufacturing industry accounts for the largest percent of GRP in the Kansas City Metro Region (41.8%), the St. Louis Metro Region (25.6%), and the South Central Region (20.9%). However, in terms of GRP dollars the advanced manufacturing industry is largest in the St. Louis Metro Region ($13.2 billion), the Kansas City Metro Region ($4.1 billion), St. Louis ($3.0 billion), Springfield Region ($1.8 billion), Kansas City ($1.7 billion) and the Central Region ($1.4 billion). Refer to Table 2.

Table 2
Advanced Manufacturing Gross Regional/State Product, 2001
Difference from baseline projection.
Numbers may not sum due to rounding.

	GROSS REGIONAL/STATE PRODUCT	
REGION	**Percent**	**Dollar Value**
Bootheel	13.4%	$569,600,000
Central	14.6%	$1,426,000,000
Kansas City	6.5%	$1,653,000,000
Kansas City Metro	41.8%	$4,069,000,000
Lake Ozark - Rolla	10.6%	$509,200,000
Lower East Central / Cape Girardeau	9.3%	$446,800,000
North Central	15.7%	$276,200,000
North East	16.1%	$471,100,000
North West	15.1%	$582,700,000
South Central	20.9%	$438,400,000
South West	12.4%	$932,700,000
Springfield	16.1%	$1,849,000,000
St. Louis	17.1%	$2,967,000,000
St. Louis Metro	25.6%	$13,150,000,000
West Central	12.6%	$483,100,000
MISSOURI GSP	**18.5%**	**$29,830,000,000**

Source: REMI Analysis by Research and Planning, MO Department of Economic Development

Employment and Wages

The advanced manufacturing industry has a significant impact on Missouri's employment base. In 2001, the advanced manufacturing industry employed 121,520 people earning $6.4 billion in wages - which translates into an annual wage per job of $52,430. This direct employment in the advanced manufacturing industry created an additional 303,280 ancillary jobs in Missouri's economy, resulting in a total impact of 424,800 jobs and $16.5 billion in wages across Missouri - which translates into an annual average wage per job of $38,912.

Both directly and indirectly, the advanced manufacturing industry has the greatest impact on the Durable Manufacturing sector, accounting for 117,100 jobs (at $47,831 per job) and $5.6 billion in wages. In the Services sector, the advanced manufacturing industry accounts for 98,660 jobs (at $33,458 per job) and $3.3 billion in wages. In the Retail Trade sector, the advanced manufacturing industry accounts for 60,160 jobs (at $17,254 per job) and $1.0 billion in wages. In the Non-Durable Manufacturing sector, the advanced manufacturing industry accounts for 38,360 jobs (at $64,520 per job) and $2.5 billion in wages. It appears that the Mining, Agriculture/Forestry/Fishing and Government sectors are marginally impacted.

In terms of average wage per job, the advanced manufacturing industry has the greatest impact on the Government sector, accounting for 6,759 jobs at $88,223 per job. In Non-Durable Manufacturing, the advanced manufacturing industry accounts for 38,360 jobs at $64,520 per job. In Durable Manufacturing, the advanced manufacturing industry accounts for 117,100 jobs at $47,831 per job. Lastly, in Wholesale Trade the advanced manufacturing industry accounts for 29,270 jobs at $46,396 per job. Refer to Table 3.

Table 3
Advanced Manufacturing Employment and Wages by Sector, 2001
Difference from baseline projection.
Numbers may not sum due to rounding.

SECTOR	EMPLOYMENT	WAGES	WAGE PER JOB
Agriculture, Forestry, Fishing	2,342.0	$32,620,000.0	$13,928.27
Construction	34,610.0	$1,121,000,000.0	$32,389.48
Finance, Insur and Real Estate	18,920.0	$767,100,000.0	$40,544.40
Government	6,759.0	$596,300,000.0	$88,223.11
Manufacturing - Durable	117,100.0	$5,601,000,000.0	$47,830.91
Manufacturing - Non-Durable	38,360.0	$2,475,000,000.0	$64,520.33
Mining	754.2	$31,890,000.0	$42,283.21
Services	98,660.0	$3,301,000,000.0	$33,458.34
Trade - Retail	60,160.0	$1,038,000,000.0	$17,253.99
Trade - Wholesale	29,270.0	$1,358,000,000.0	$46,395.63
Transport, Comm. & Public Utilities	17,850.0	$808,400,000.0	$45,288.52
TOTAL	**424,800.0**	**$16,530,000,000.0**	**$38,912.43**

Source: REMI Analysis by Research and Planning, MO Department of Economic Development

The advanced manufacturing industry also has positive economic impacts within the regional economies of Missouri as well. In 2001, the direct employment of 121,520 jobs in the advanced manufacturing industry results in the creation of 303,280 ancillary jobs in the state economy - resulting in a total impact of 424,800 jobs and $16.5 billion in wages across Missouri.

The St. Louis Metro Region is most positively affected by the advanced manufacturing industry, accounting for 185,500 jobs (at $44,927 per job) and $8.3 billion in wages. In the Kansas City Metro Region, the advanced manufacturing industry accounts for 50,960 jobs (at $38,462 per job) and $2.0 billion wages. In St. Louis, the advanced manufacturing industry accounts for 35,800 jobs (at $48,855 per job) and $1.8 billion wages. Lastly, in Kansas City the advanced manufacturing industry accounts for 31,650 jobs (at $43,223 per job) and $1.4 billion wages.

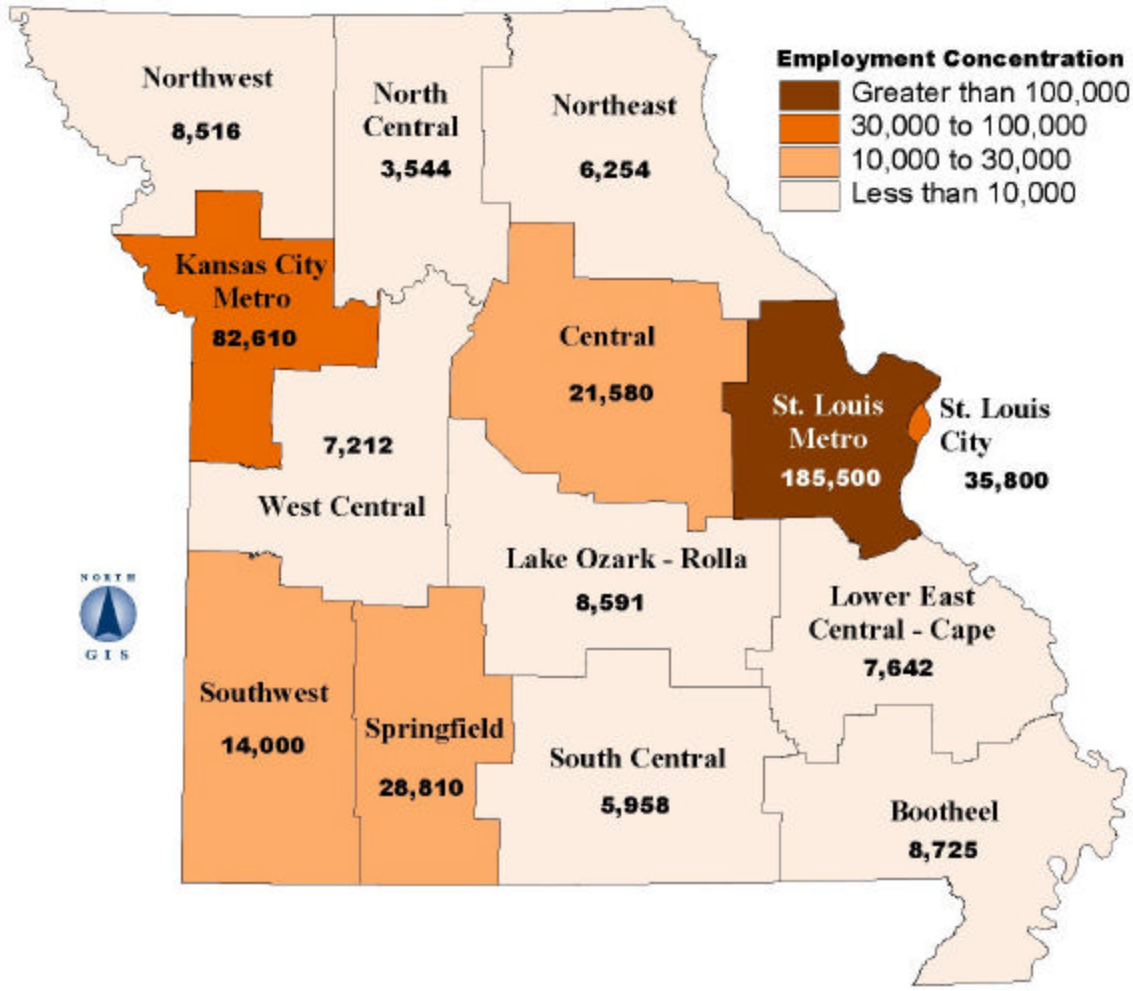
In general, most other regions in the state are only moderately impacted by the advanced manufacturing industry. Refer to Table 4 and Map 3.

Table 4
Advanced Manufacturing Employment and Wages by Region, 2001
Difference from baseline projection.
Numbers may not sum due to rounding.

REGION	EMPLOYMENT	WAGES	WAGE PER JOB
Bootheel	8,725.0	$216,200,000.0	$24,779.37
Central	21,580.0	$588,900,000.0	$27,289.16
Kansas City	31,650.0	$1,368,000,000.0	$43,222.75
Kansas City Metro	50,960.0	$1,960,000,000.0	$38,461.54
Lake Ozark - Rolla	8,591.0	$190,600,000.0	$22,186.01
Lower East Central / Cape Girardeau	7,642.0	$207,700,000.0	$27,178.75
North Central	3,544.0	$80,050,000.0	$22,587.47
North East	6,254.0	$152,200,000.0	$24,336.42
North West	8,516.0	$232,500,000.0	$27,301.55
South Central	5,958.0	$120,100,000.0	$20,157.77
South West	14,000.0	$361,700,000.0	$25,835.71
Springfield	28,810.0	$785,300,000.0	$27,257.90
St. Louis	35,800.0	$1,749,000,000.0	$48,854.75
St. Louis Metro	185,500.0	$8,334,000,000.0	$44,927.22
West Central	7,212.0	$188,400,000.0	$26,123.13
MISSOURI	**424,800.0**	**$16,530,000,000.0**	**$38,912.43**

Source: REMI Analysis by Research and Planning, MO Department of Economic Development

Map 3
Advanced Manufacturing Employment by Region, 2001



Source: REMI Analysis by Research and Planning, MO Department of Economic Development

Occupational Structure

Both directly and indirectly, the advanced manufacturing industry supports four main occupational groups in Missouri. First, advanced manufacturing employs 56.8% of all Assembly and Fabrication Hand Workers in the state, comprising 25,110 employees in the industry. Second, advanced manufacturing employs 43.1% of all Plant and Utility Operators in the state, comprising 1,636 employees in the industry. Third, advanced manufacturing employs 39.8% of all Precision Production workers in the state, comprising 20,767 employees in the industry. Lastly, advanced manufacturing employs 34.9% of all Machine Operators and Setters in the state, comprising 29,374 employees in the industry. However, in terms of actual numbers of occupational employees, the advanced manufacturing industry employs 68,298 Administrative and Support workers, 45,311 Professionals, 45,090 Executives and Managers, 44,091 Marketing and Sales workers, and 41,170 Personal Service workers. Refer to Table 5.

Table 5
Advanced Manufacturing Occupational Structure, 2001
Difference from baseline projection.
Numbers may not sum due to rounding.

OCCUPATION	INDUSTRY OCCUPATIONAL EMPLOYMENT	PERCENT OF STATE OCCUPATION
Administrative Support & Clerical	68,297.5	11.88%
Agriculture, Forestry & Fishing Workers	3,566.3	2.76%
Blue Collar Worker Supervisors	9,220.0	26.12%
Construction Trades	16,670.0	23.15%
Executive, Managerial & Administrators	45,090.0	15.85%
Extractive Workers - Mining, Oil & Gas	537.0	17.26%
Hand Workers - Assembly & Fabrication	25,110.0	56.80%
Laborers & Material Movers	20,990.0	17.70%
Machine Operators & Setters	29,373.7	34.97%
Marketing & Sales	44,090.8	13.26%
Mechanics & Installers - Communications, Electric & Mechanical	21,070.8	16.92%
Plant & Utility Operators	1,636.0	43.09%
Precision Production - Assembly, Food, Metal & Printing	20,767.4	39.82%
Professional	45,310.5	9.39%
Service - Personal	41,169.5	8.59%
Technicians - Engineering, Health and Sciences	13,766.0	12.79%
Transportation Workers	18,134.4	14.12%
TOTAL	**424.800.0**	**13.90%**

Source: REMI Analysis by Research and Planning, MO Department of Economic Development

IV. Growth/Loss Scenario

In the growth/loss scenario, regional and state impacts are ascertained by examining the difference between the baseline projection (no gain/loss of jobs) and the scenario projection (gain/loss of 100 jobs). The differential indicates the impact above or below what would have been expected if no change in the economy had occurred.

Gross Regional/State Impacts

The gain/loss of 100 jobs in the advanced manufacturing industry in Missouri would result in a 0.015% increase/decrease in Missouri's gross state product (GSP) in 2001, translating into a $24.8 million dollar GSP gain/loss. By 2011, the impact on GSP remains fairly constant, with a 0.014% or $26.9 million dollar increase/decrease in GSP.

The gain/loss of 100 advanced manufacturing jobs also impacts gross regional product (GRP) in Missouri. The Kansas City Metro Region would experience the largest impact, resulting in a 0.035% increase/decrease in GRP. The St. Louis Metro Region would experience the second largest impact, resulting in a 0.021% increase/decrease in GRP. Lastly, the North East Region would experience the third largest impact, resulting in a 0.017% increase/decrease in GRP. Refer to Table 6.

Table 6
Projected Gross Regional/State Product Impacts, 2001-2011
Difference from baseline projection per 100 job increase/decrease.
Numbers may not sum due to rounding.

	GROSS REGIONAL/STATE PRODUCT CHANGE		
REGION	2001	2006	2011
Bootheel	0.013%	0.013%	0.013%
Central	0.014%	0.015%	0.015%
Kansas City	0.005%	0.004%	0.004%
Kansas City Metro	0.035%	0.035%	0.033%
Lake Ozark - Rolla	0.007%	0.007%	0.007%
Lower East Central / Cape Girardeau	0.004%	0.003%	0.003%
North Central	0.015%	0.015%	0.015%
North East	0.017%	0.016%	0.017%
North West	0.012%	0.013%	0.012%
South Central	0.016%	0.017%	0.017%
South West	0.009%	0.009%	0.008%
Springfield	0.015%	0.015%	0.015%
St. Louis	0.013%	0.011%	0.011%
St. Louis Metro	0.021%	0.019%	0.018%
West Central	0.011%	0.012%	0.011%
MISSOURI GSP - Percent Change	**0.015%**	**0.014%**	**0.014%**
MISSOURI GSP - Dollar Change	**$24,750,000.0**	**$25,380,000.0**	**$26,920,000.0**

Source: REMI Analysis by Research and Planning, MO Department of Economic Development

Employment and Wage Impacts

As demonstrated above, the gain/loss of 100 advanced manufacturing jobs would have a small economic impact on Missouri's gross state product. However, the industry has a significant impact on employment and wages in Missouri. Regional and state impacts are ascertained by examining the difference between the baseline projection (no gain/loss of jobs) and the scenario projection (gain/loss of 100 jobs). The differential indicates the number of jobs above or below what would have been expected if no change in the economy had occurred.

In 2001, the gain/loss of 100 advanced manufacturing jobs would result in the gain/loss of 253 ancillary jobs in Missouri - for a total gain/loss of 353 jobs and $14.2 million in wages across the state. By 2011, the total impact steadily drops to 301 jobs and $15.1 million in wages.

The Durable Manufacturing sector would be most impacted, resulting in the gain/loss of 95.2 jobs (at $49,947 per job) and $4.8 million wages in 2001. By 2011 the impact steadily drops, with the projected gain/loss of 83.1 jobs and $5.6 million in wages. This indicates a significant economic impact, since the average wage per job is relatively high. The Services sector would also be significantly impacted, resulting in the gain/loss of 82.6 jobs (at $34,209 per job) and $2.8 million wages in 2001. However, by 2011 the impact decreases moderately, with the projected gain/loss of 68.1 jobs and $3.0 million in wages. The Retail Trade sector would also be moderately impacted, resulting in the gain/loss of 51 jobs (at $17,474 per job) and $891,700 wages in 2001. However, by 2011 the impact decreases moderately, with the projected gain/loss of 37.8 jobs and $785,800 in wages.

It appears that the Mining, Agriculture/Forestry/Fishing and Government sectors are marginally impacted in 2001. However, by 2011 the Government sector experiences a moderate increase in jobs. This growth is attributable to the increase in population by 2011, which leads to increased demand for public services. Refer to Tables 7 and 8.

Table 7
Projected Employment Impacts by Sector, 2001-2011
Difference from baseline projection per 100 job increase/decrease.
Numbers may not sum due to rounding.

	2001		2006		2011	
SECTOR	JOB CHANGE	WAGE PER JOB	JOB CHANGE	WAGE PER JOB	JOB CHANGE	WAGE PER JOB
Agriculture, Forestry, Fishing	1.9	$14,190	1.5	$18,441	1.4	$17,677
Construction	28.9	$33,613	17.5	$42,814	12.1	$48,672
Finance, Insur and Real Estate	15.7	$41,291	12.5	$51,579	11.3	$49,504
Government	5.2	$93,755	21.2	$55,366	26.1	$54,479
Manufacturing - Durable	95.2	$49,947	85.5	$59,321	83.1	$67,863
Manufacturing - Non-Durable	32.1	$67,735	28.8	$81,916	28.5	$91,474
Mining	0.6	$43,023	0.4	$52,734	0.3	$58,054
Services	82.6	$34,209	68.5	$41,560	68.1	$44,289
Trade - Retail	51.0	$17,474	40.2	$21,444	37.8	$20,799
Trade - Wholesale	24.4	$47,170	21.7	$56,042	20.4	$58,688
Transport, Comm. & Public Utilities	15.0	$45,926	12.5	$55,866	11.9	$54,313
TOTAL	**353.0**	**$40,085**	**310.3**	**$46,729**	**301.0**	**$50,100**

Source: REMI Analysis by Research and Planning, MO Department of Economic Development

Table 8
Projected Wage Impacts by Sector, 2001-2011
Difference from baseline projection per 100 job increase/decrease.
Numbers may not sum due to rounding.
Adjusted to 2001 Dollars.

	WAGE CHANGE		
SECTOR	2001	2006	2011
Agriculture, Forestry, Fishing	$27,600.0	$27,090.0	$24,200.0
Construction	$970,400.0	$750,100.0	$586,500.0
Finance, Insur and Real Estate	$649,500.0	$643,700.0	$558,900.0
Government	$486,400.0	$1,171,000.0	$1,423,000.0
Manufacturing - Durable	$4,754,000.0	$5,069,000.0	$5,636,000.0
Manufacturing - Non-Durable	$2,177,000.0	$2,360,000.0	$2,607,000.0
Mining	$26,300.0	$21,700.0	$18,850.0
Services	$2,827,000.0	$2,846,000.0	$3,017,000.0
Trade - Retail	$891,700.0	$861,200.0	$785,800.0
Trade - Wholesale	$1,150,000.0	$1,215,000.0	$1,199,000.0
Transport, Comm. & Public Utilities	$686,600.0	$700,000.0	$644,700.0
TOTAL	**$14,150,000.0**	**$14,500,000.0**	**$15,080,000.0**

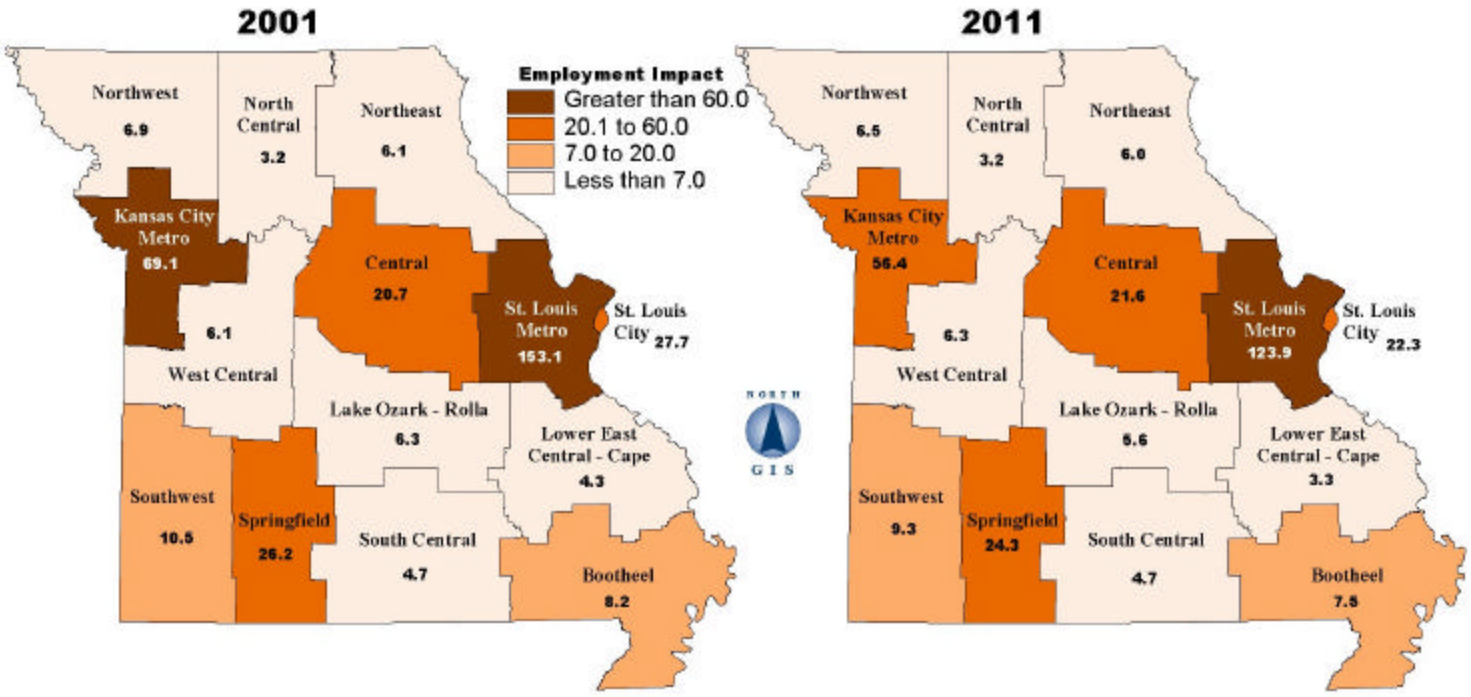
Source: REMI Analysis by Research and Planning, MO Department of Economic Development

Change in the advanced manufacturing industry also has differential impacts on Missouri's regional economies. In 2001, the gain/loss of 100 advanced manufacturing jobs in Missouri would result in the loss of 253 ancillary jobs in the state economy - for a total loss of 353 jobs and $14.2 million in wages across Missouri. By 2011, the total impact steadily drops to 301 jobs and $15.1 million in wages.

The St. Louis Metro Region is most impacted by changes in the advanced manufacturing industry, with the gain/loss of 153.1 jobs (at $47,538 per job) and $7.3 million in wages. The Kansas City Metro Region experiences the gain/loss of 42.4 jobs (at $40,368 per job) and $1.7 million wages.

In general, most other regions in the state are only moderately or marginally impacted by changes in the advanced manufacturing industry. Refer to Map 4 and Tables 9 and 10.

Map 4
Projected Employment Impacts by Region, 2001-2011



Source: REMI Analysis by Research and Planning, MO Department of Economic Development

Table 9
Projected Employment Impacts by Region, 2001-2011
Difference from baseline projection per 100 job increase/decrease.
Numbers may not sum due to rounding.

	2001		2006		2011	
REGION	JOB CHANGE	WAGE PER JOB	JOB CHANGE	WAGE PER JOB	JOB CHANGE	WAGE PER JOB
Bootheel	8.2	$25,614	7.7	$29,813	7.5	$32,512
Central	20.7	$31,288	21.6	$37,686	21.6	$41,401
Kansas City	26.7	$46,689	21.5	$57,449	20.7	$55,872
Kansas City Metro	42.4	$40,368	38.3	$50,379	35.7	$59,653
Lake Ozark - Rolla	6.3	$23,994	5.8	$29,274	5.6	$31,843
Lower East Central / Cape Girardeau	4.3	$28,738	3.4	$34,438	3.3	$35,044
North Central	3.2	$24,621	3.2	$28,245	3.2	$30,365
North East	6.1	$27,517	6.0	$32,312	6.0	$35,551
North West	6.9	$29,923	6.5	$35,615	6.5	$38,812
South Central	4.7	$22,075	4.6	$26,279	4.7	$28,722
South West	10.5	$26,410	9.6	$31,974	9.3	$34,734
Springfield	26.2	$29,503	24.7	$36,092	24.3	$39,371
St. Louis	27.7	$52,948	22.4	$62,550	22.3	$61,728
St. Louis Metro	153.1	$47,538	128.8	$58,556	123.9	$64,044
West Central	6.1	$27,620	6.3	$31,971	6.3	$34,422
MISSOURI	**353.0**	**$40,085**	**310.3**	**$46,729**	**301.0**	**$50,100**

Source: REMI Analysis by Research and Planning, MO Department of Economic Development

Table 10
Projected Wage Impacts by Region, 2001-2011
Difference from baseline projection per 100 job increase/decrease.
Numbers may not sum due to rounding.
Adjusted to 2001 Dollars.

	WAGE CHANGE		
REGION	2001	2006	2011
Bootheel	$209,500.0	$229,500.0	$245,300.0
Central	$646,100.0	$812,500.0	$892,200.0
Kansas City	$1,248,000.0	$1,234,000.0	$1,156,000.0
Kansas City Metro	$1,710,000.0	$1,927,000.0	$2,129,000.0
Lake Ozark - Rolla	$151,400.0	$170,200.0	$178,800.0
Lower East Central / Cape Girardeau	$123,000.0	$118,500.0	$114,700.0
North Central	$78,320.0	$90,300.0	$98,230.0
North East	$166,700.0	$194,000.0	$214,800.0
North West	$205,000.0	$232,600.0	$250,800.0
South Central	$103,400.0	$121,200.0	$133,900.0
South West	$277,300.0	$305,900.0	$323,300.0
Springfield	$771,500.0	$892,200.0	$957,500.0
St. Louis	$1,464,000.0	$1,403,000.0	$1,379,000.0
St. Louis Metro	$7,278,000.0	$7,542,000.0	$7,935,000.0
West Central	$169,200.0	$201,000.0	$217,200.0
MISSOURI	**$14,150,000.0**	**$14,500,000.0**	**$15,080,000.0**

Source: REMI Analysis by Research and Planning, MO Department of Economic Development

Occupational Impacts

The gain/loss of 100 advanced manufacturing jobs would affect five main occupational groups in Missouri. First, there would be a gain/loss of 56.9 Administrative Support and Clerical workers in 2001, with a -18.8% decline by 2011. This group includes administrative assistants, clerks and secretaries. Second, there would be a gain/loss of 37.4 Professionals in 2001, with a 23.3% increase by 2011. This group includes engineers, life scientists, physical scientists and social scientists. Third, there would be a gain/loss of 37.4 Executives and Managers in 2001, with a -16.8% decline by 2011. This group includes managers and managerial support professionals. Fourth, there would be a gain/loss of 37 Marketing and Sales in 2001, with a -20.8% decline by 2011. This group includes finance, marketing and sales workers. Lastly, there would be a gain/loss of 34.7 Service workers in 2001, with a -16.7% decline by 2011. This group includes food, health, personal and protective service workers. Refer to Table 11.

Table 11
Projected Occupational Impacts, 2001-2011
Difference from baseline projection per 100 job increase/decrease.
Numbers may not sum due to rounding.

	OCCUPATIONAL CHANGE		
OCCUPATION	**2001**	**2006**	**2011**
Administrative Support & Clerical	56.9	48.4	46.2
Agriculture, Forestry & Fishing Workers	3.0	2.3	2.2
Blue Collar Worker Supervisors	7.6	6.2	5.7
Construction Trades	13.9	9.3	7.1
Executive, Managerial & Administrators	37.4	32.4	31.1
Extractive Workers - Mining, Oil & Gas	14.3	9.6	7.4
Hand Workers - Assembly & Fabrication	20.7	18.1	17.4
Laborers & Material Movers	17.5	14.4	13.3
Machine Operators & Setters	24.3	21.8	21.5
Marketing & Sales	37.0	30.9	29.3
Mechanics & Installers - Communications, Electric, Mechanical	17.5	14.9	14.0
Plant & Utility Operators	1.3	1.2	1.2
Precision Production - Assembly, Food, Metal & Printing	16.9	14.4	13.7
Professional	37.4	42.9	46.1
Service - Personal	34.7	29.0	28.9
Technicians - Engineering, Health and Sciences	11.3	10.2	10.3
Transportation Workers	15.1	13.4	12.8
TOTAL	**353.0**	**310.3**	**301.0**

Source: REMI Analysis by Research and Planning, MO Department of Economic Development

Population Impacts

Missouri would experience a small change in population through 2011 due the gain/loss of 100 advanced manufacturing jobs. In 2001, Missouri would experience the gain/loss of 85.5 people, with about 50% coming from the St. Louis metropolitan area. By 2011, this gain/loss expands to 422.4 people, again with about 50% coming from the St. Louis metropolitan area.

This growth in population will also generate an increased demand for public services, which leads to growth in Government sector employment. Refer to Table 12.

Table 12
Projected Population Impacts by Region, 2001-2011
Difference from baseline projection per 100 job increase/decrease.
Numbers may not sum due to rounding.

	POPULATION CHANGE		
REGION	**2001**	**2006**	**2011**
Bootheel	2.4	9.5	12.2
Central	5.0	20.7	26.1
Kansas City	6.2	27.5	33.1
Kansas City Metro	8.4	25.5	31.1
Lake Ozark - Rolla	2.0	7.8	9.6
Lower East Central / Cape Girardeau	1.5	6.1	7.4
North Central	1.0	4.1	5.3
North East	2.0	7.4	9.5
North West	2.1	8.1	10.3
South Central	1.5	6.3	8.2
South West	2.6	10.6	13.5
Springfield	6.3	26.1	33.2
St. Louis	5.9	22.5	27.0
St. Louis Metro	37.1	150.4	185.3
West Central	2.0	8.4	10.8
MISSOURI	**85.5**	**339.8**	**422.4**

Source: REMI Analysis by Research and Planning, MO Department of Economic Development

V. Implications and Summary

Advanced manufacturing is designated as one of Missouri's targeted industries for economic development and growth, and is actively supported by the State of Missouri. The Missouri Department of Economic Development is a catalyst promoting synergies and partnerships statewide on behalf of advanced manufacturing development. Advanced manufacturing enjoys high visibility, and developments are tracked closely in both Missouri and the United States. Development of the advanced manufacturing industry leads to improvements in computing power, communication and information technology which result in higher rates of productivity growth and higher real wages. Given these trends, state and local officials in Missouri need to know how advanced manufacturing affects the regional and state economy.

Advanced manufacturing employment in Missouri was estimated at 121,520 in 2000, a decrease of -20.9% since 1990. Total annual real wages during 2000 in the advanced manufacturing industry in Missouri was estimated at $6.37 billion, a decrease of -9.1% since 1990. Estimated annual average real wages per job during 2000 in the advanced manufacturing industry was $52,430, an increase of 14.9% since 1990. The number of advanced manufacturing firms in Missouri in 2000 was estimated at 1,348, an increase of 15.3% since 1990. In 2000, the advanced manufacturing industry accounted for 4.6% of total employment and 7.8% of total wages in Missouri. The majority of advanced manufacturing jobs were located in metropolitan St. Louis, Kansas City, Springfield and Columbia.

The advanced manufacturing industry accounts for 18.5% of Missouri's GSP, which is equivalent to $29.8 billion dollars in 2001. The advanced manufacturing industry accounts for the largest percent of GRP in the Kansas City Metro Region (41.8%), the St. Louis Metro Region (25.6%), and the South Central Region (20.9%). However, in terms of GRP dollars the advanced manufacturing industry is largest in the St. Louis Metro Region ($13.2 billion), the Kansas City Metro Region ($4.1 billion), St. Louis ($3.0 billion), Springfield Region ($1.8 billion), Kansas City ($1.7 billion) and the Central Region ($1.4 billion).

In 2001, the advanced manufacturing industry employed 121,520 people earning $6.4 billion in wages - which translates into an annual wage per job of $52,430. This direct employment in the advanced manufacturing industry created an additional 303,280 ancillary jobs in Missouri's economy, resulting in a total impact of 424,800 jobs and $16.5 billion in wages across Missouri - which translates into an annual average wage per job of $38,912. Both directly and indirectly, the advanced manufacturing industry has the greatest impact on the Durable Manufacturing sector, accounting for 117,100 jobs (at $47,831 per job) and $5.6 billion in wages. In the Services sector, the advanced manufacturing industry accounts for 98,660 jobs (at $33,458 per job) and $3.3 billion in wages. In the Retail Trade sector, the advanced manufacturing industry accounts for 60,160 jobs (at $17,254 per job) and $1.0 billion

in wages. In the Non-Durable Manufacturing sector, the advanced manufacturing industry accounts for 38,360 jobs (at $64,520 per job) and $2.5 billion in wages. It appears that the Mining, Agriculture/Forestry/Fishing and Government sectors are marginally impacted.

The St. Louis Metro Region is most positively affected by the advanced manufacturing industry, accounting for 185,500 jobs (at $44,927 per job) and $8.3 billion in wages. In the Kansas City Metro Region, the advanced manufacturing industry accounts for 50,960 jobs (at $38,462 per job) and $2.0 billion wages. In St. Louis, the advanced manufacturing industry accounts for 35,800 jobs (at $48,855 per job) and $1.8 billion wages. Lastly, in Kansas City the advanced manufacturing industry accounts for 31,650 jobs (at $43,223 per job) and $1.4 billion wages. In general, most other regions in the state are only moderately impacted by the advanced manufacturing industry.

Both directly and indirectly, the advanced manufacturing industry supports four main occupational groups in Missouri. First, advanced manufacturing employs 56.8% of all Assembly and Fabrication Hand Workers in the state, comprising 25,110 employees in the industry. Second, advanced manufacturing employs 43.1% of all Plant and Utility Operators in the state, comprising 1,636 employees in the industry. Third, advanced manufacturing employs 39.8% of all Precision Production workers in the state, comprising 20,767 employees in the industry. Lastly, advanced manufacturing employs 34.9% of all Machine Operators and Setters in the state, comprising 29,374 employees in the industry. However, in terms of actual numbers of occupational employees, the advanced manufacturing industry employs 68,298 Administrative and Support workers, 45,311 Professionals, 45,090 Executives and Managers, 44,091 Marketing and Sales workers, and 41,170 Personal Service workers.

References

Hecker, Daniel. 1999. "High Technology Employment: A Broader Overview." *Monthly Labor Review*, June 1999. Bureau of Labor Statistics: Washington, DC.

Riche, Richard, Daniel Hecker and John Burgan. 1983. "High Technology Today and Tomorrow: A Small Slice of the Employment Pie." *Monthly Labor Review*, November 1983. Bureau of Labor Statistics: Washington, DC.

U.S. House of Representatives. 1998. Monetary Policy Testimony and Report to Congress, Testimony of Alan Greenspan Before the Subcommittee on Domestic and International Monetary Policy of the Committee on Banking and Financial Services, United States House of Representatives. February 24, 1998: Washington, DC.

Appendix A - Industry Definitions

Advanced Manufacturing Industry Definition by Standard Industry Classification

SIC	Description
281	Industrial Inorganic Chemicals
282	Plastics Materials and Synthetics
283	Drugs
284	Soap, Cleaners and Toilet Goods
285	Paints and Allied Products
286	Industrial Organic Chemicals
287	Agricultural Chemicals
289	Miscellaneous Chemical Products
291	Petroleum Refining
348	Ordnance and Accessories
351	Engines and Turbines
353	Construction and Related Machinery
355	Special Industrial Machinery
356	General Industrial Machinery
357	Computer and Office Equipment
361	Electric Distribution Equipment
362	Electrical Industrial Apparatus
365	Household and Audio and Video Equipment
366	Communications Equipment
367	Electronic Components and Accessories
371	Motor Vehicles and Equipment
372	Aircraft and Parts
376	Guided Missiles and Space Vehicles
381	Search and Navigation Equipment
382	Measuring and Controlling Devices
384	Medical Instruments and Supplies
386	Photographic Equipment and Supplies

The Bureau of Labor Statistics defines advanced manufacturing, or high technology, as those firms engaged in the design, development, and introduction of new products and innovative manufacturing processes through the systematic application of scientific and technical knowledge.

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